

## WHAT IS CLAIMED IS:

- 1        1. An integrated Low Dropout (LDO) linear voltage regulator providing improved  
2 current limiting, comprising:
  - 3            a 2-input, 1-output differential voltage amplifier, a first input receiving a reference  
4 voltage;
  - 5            a circuit to sense the output voltage of the voltage regulator and couple it to a second  
6 input of the differential voltage amplifier in a manner that provides negative feedback;
  - 7            a series pass transistor connected to the output of the difference voltage amplifier;
  - 8            a current sense transistor coupled to the series pass transistor using current mirroring to  
9 monitor the current passing through it;
  - 10          a reference current source coupled to the output of the current sense transistor; and  
11          the junction of the current sense transistor and the reference current source being  
12 connected to the difference voltage amplifier in a manner that increases an apparently sensed  
13 output voltage as the current through the current sense transistor exceeds the reference current  
14 value.

- 1        2. The integrated Low Dropout (LDO) linear voltage regulator as in claim 1,  
2 wherein the differential voltage amplifier is a long-tailed pair having a constant current source  
3 for providing a tail current.

1           3.     The integrated Low Dropout (LDO) linear voltage regulator as in claim 1,  
2     wherein the circuit for sensing the output voltage of the voltage regulator comprises a direct  
3     connection of the output of the voltage regulator to the second input of the difference amplifier.

1           4.     The integrated Low Dropout (LDO) linear voltage regulator as in claim 2,  
2     wherein the junction of the current sense transistor and the reference current source is connected  
3     to the control terminal of a current limiting transistor that is connected in parallel with the  
4     transistor of the long-tailed pair that has its control terminal as the second input of the difference  
5     amplifier.

1           5.       A method for improving current limiting in an integrated low Drop Out (LDO)  
2       linear voltage regulator, comprising:  
3               receiving a reference voltage at a first input of a difference voltage amplifier;  
4               sensing a regulator output voltage;  
5               applying the sensed regulator output voltage to a second input of the difference  
6       voltage amplifier in a manner that provides negative feedback;  
7               sensing current passing through the regulator output;  
8               comparing the sensed current to a reference current; and  
9               controlling operation of the difference voltage amplifier in a manner that  
10      increases the apparently sensed regulator output voltage if the sensed current exceeds the  
11      reference current.

1           6.       The method as in claim 5, wherein applying the sensed regulator output voltage  
2       comprises directly connecting the sensed regulator output voltage regulator to the second input  
3       of the difference voltage amplifier.

1           7.     A low drop-out voltage regulator, comprising:

2                   a differential amplifier stage including:

3                           a differential amplifier having first and second differential inputs, the first

4     differential input coupled to an output of the regulator and the second differential input coupled

5     to a reference voltage; and

6                           a current control transistor coupled to one branch of the differential

7     amplifier; and

8                           an output stage including:

9                           a pass transistor coupled between a regulator input and the regulator

10   output and controlled by an output of the differential amplifier; and

11                           a current sensing transistor coupled between the regulator input and the

12   current control transistor of the differential amplifier.

1           8.     The regulator of claim 7 wherein a first reference terminal of the differential

2     amplifier is coupled to the regulator input and a second reference terminal of the differential

3     amplifier is coupled to ground.

1           9.     The regulator of claim 8, wherein the differential amplifier stage further includes

2     a tail current transistor coupled between the second reference terminal and ground.

1           10.   The regulator of claim 7, wherein the output stage further includes a biasing

2     transistor coupled between the pass transistor and ground.

1           11. The regulator of claim 7, wherein the output stage further includes a current  
2 limiting transistor coupled between the current sensing transistor and ground.

1           12.    A regulator, comprising:

2                   a regulator input;

3                   a regulator output;

4                   a differential amplifier coupled to the regulator input and having first and second

5           current paths associated with corresponding first and second differential input and an output in

6           the second current path, the first differential input coupled to the regulator output and the second

7           differential input receiving a reference voltage;

8                   a current control transistor coupled to a first current path;

9                   a pass transistor coupled between the regulator input and regulator output and

10          having a control terminal coupled to the differential amplifier input; and

11                   a current sensor to sense current at the regulator output and generate a control

12          signal applied to the current control transistor.

- 1        13.    A method, comprising:
  - 2            sensing an output regulated voltage;
  - 3            comparing the output regulated voltage to a reference voltage;
  - 4            controlling the output voltage through negative feedback to substantially match
  - 5            the reference voltage;
  - 6            sensing a current associated with the output voltage;
  - 7            comparing the sensed current to a reference current;
  - 8            if the sensed current exceeds the reference current, then overriding the sensing of
  - 9            the output regulated voltage to sense an apparent, higher, voltage.

1           14.    A regulator, comprising:

2               a negative feedback voltage control circuit that senses an output regulated voltage  
3    and controls that sensed output regulated voltage to substantially match a reference voltage;

4               a current sensor that senses a current associated with the output regulated voltage  
5    and compares the sensed current to a reference current; and

6               a feedback control circuit responsive to sensed current exceeding the reference  
7    current to override the negative feedback voltage control circuit sensing of the output regulated  
8    voltage to sense an apparent, higher, voltage.

1           15.    The regulator of claim 14 wherein the negative feedback voltage control circuit  
2    comprises:

3               a differential amplifier including first and second mirrored current paths, a current  
4    flowing in the first current path being controlled by the output regulated voltage, and a current  
5    flowing in the second current path controlling the sensed output regulated voltage to  
6    substantially match the reference voltage;

7               an override circuit coupled to the first current path and responsive to the feedback  
8    control circuit to maintain current flowing in the first current path as the output regulated voltage  
9    decreases.